National Semiconductor

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SM72240

SolarMagic 5-Pin Microprocessor Reset Circuit

General Description

The SM72240 microprocessor supervisory circuit monitors the power supplies in microprocessor and digital systems. It provides a reset to the microprocessor during power-up, power-down, brown-out conditions, and manual reset.

The SM72240 asserts a reset signal whenever the supply decreases below the factory-programmed reset threshold. Reset will be asserted for at least 100ms even after V_{CC} rises above the reset threshold.

The SM72240 has an active-low open-drain $\overline{\text{RESET}}$ output.

The SM72240 is suitable for monitoring 5V. With a low supply current of only 6µA, the SM72240 is ideal for use in portable equipment. The SM72240 is available in the 5-pin SOT23 package.

Features

- Renewable Energy Grade
- Precise monitoring of 5V supply voltages
- Fully specified over temperature
  −40°C to +125°C
- 100 ms minimum Power-On Reset pulse width, 190 ms typical:
  Active-Low $\overline{\text{RESET}}$ Open Drain Output
- Guaranteed $\overline{\text{RESET}}$ Output valid for $V_{CC} \geq 1V$
- Low Supply Current, 6µA typical
- Power supply transient immunity
- Compatible with MAX811/812 applications

Applications

- Microprocessor Systems
- Computers
- Controllers
- Intelligent Instruments
- Portable/Battery-Powered Equipment

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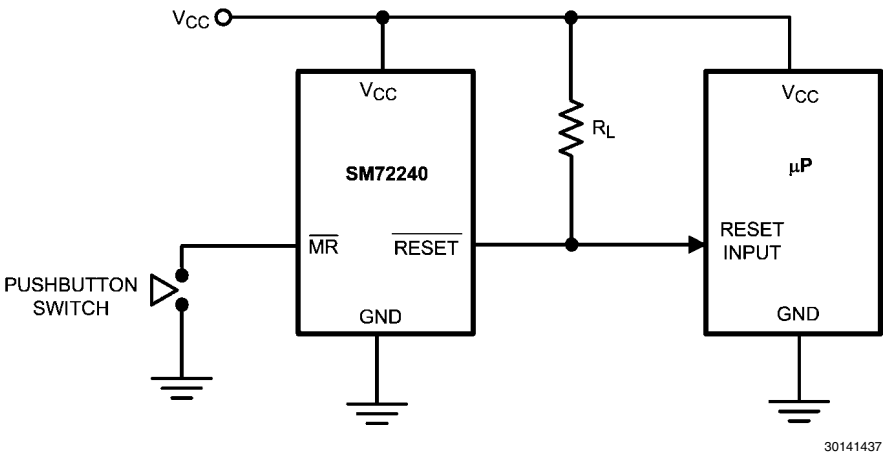
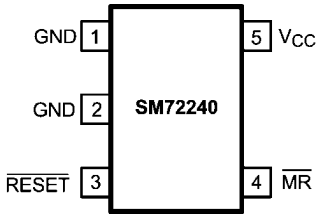
Typical Application Circuit



Connection Diagram

SOT23-5



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Pin Descriptions

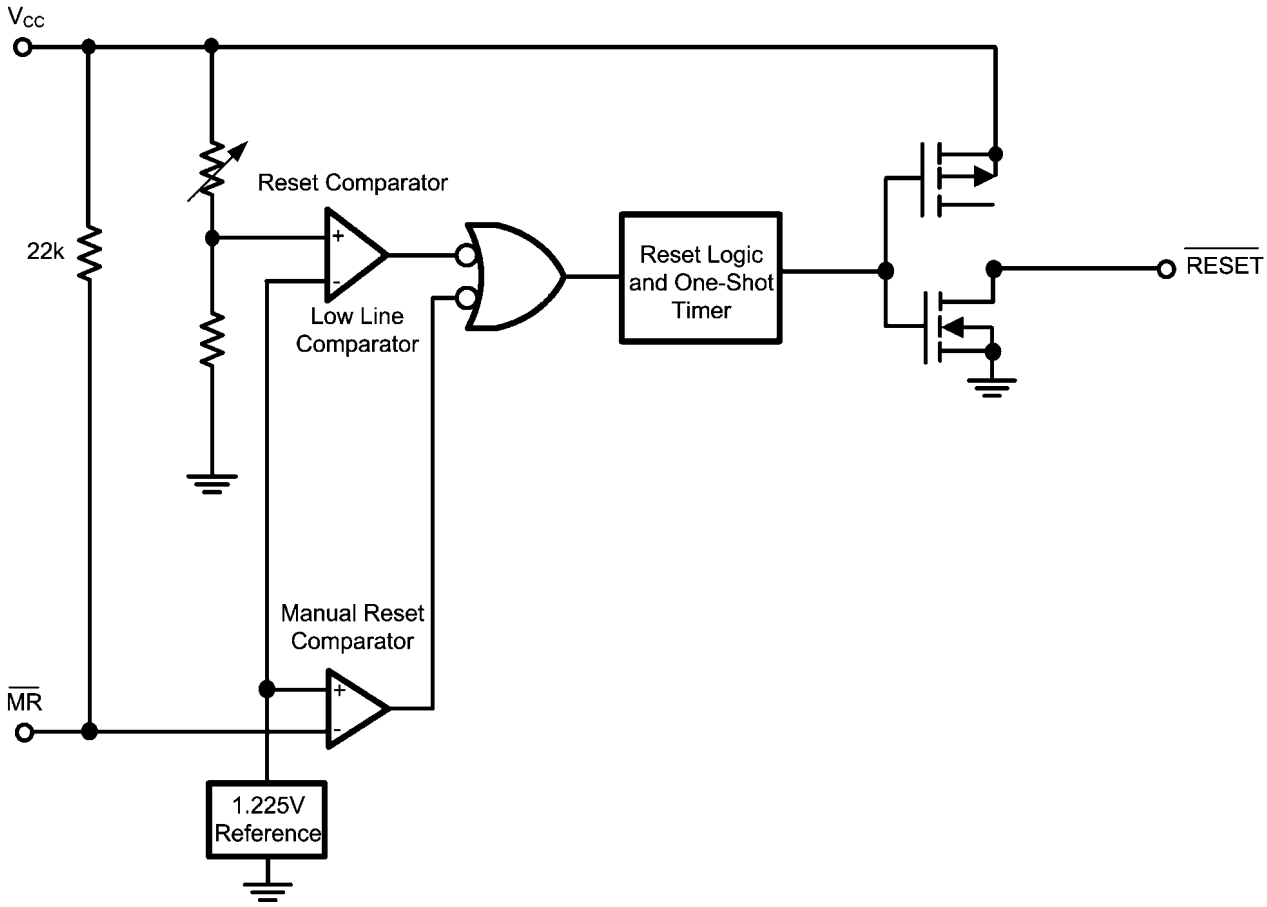
Pin	Name	Function
1	GND	Ground reference
2	GND	Ground reference, device substrate, connect to ground.
3	$\overline{\text{RESET}}$	Active-low output. $\overline{\text{RESET}}$ remains low while V_{CC} is below the reset threshold voltage, and for 190 ms after V_{CC} rises above the reset threshold voltage.
4	$\overline{\text{MR}}$	Active-low input. Reset is asserted whenever this pin is pulled low and remains asserted for 190 ms after the $\overline{\text{MR}}$ pin goes high. May be left open.
5	V_{CC}	Supply Voltage (+5V, nominal)

Ordering Information

Reset Threshold (V)	Supplied as 250 units, tape & reel	Supplied as 1000 units, tape & reel	Supplied as 3000 units, tape & reel	Package Type	Package Top Mark	NSC Package
4.63	SM72240MFE–4.63	SM72240MF–4.63	SM72240MFX–4.63	SOT23-5	2240	MF05A
3.08	SM72240MFE–3.08	SM72240MF–3.08	SM72240MFX–3.08	SOT23–5	R133	MF05A

Block Diagram

SM72240 Block Diagram



Absolute Maximum Ratings (*Note 1*)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

V_{CC}, $\overline{MR}$	−0.3V to 6.0V
RESET, $\overline{RESET}$	−0.3V to (V_{CC}+ 0.3V)
Input Current, V_{CC} Pin	20mA
Output Current, RESET, $\overline{RESET}$ Pin	20mA
ESD Rating (*Note 2*)	2kV
Continuous Power Dissipation (T_A = +70°C)	
SOT-23 (*Note 3*)	320mW
Operating Temperature Range	−40°C to +125°C
Maximum Junction Temperature	125°C
Storage Temperature Range	−65°C to +160°C
Lead Temperature (soldering, 10sec)	+300°C

Electrical Characteristics

Typical values are at T_A = +25°C. Limits with standard typeface are for T_A = +25°C, and limits in boldface type apply for the operating temperature range −40°C to +125°C , unless otherwise noted. (*Note 4*)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{CC}	V_{CC} Range			**1.0**		**5.5**	V
I_{CC}	Supply Current (I_{LOAD} = 0A)	SM72240-4.63	V_{CC} = 5.5V		8	**15**	µA
		SM72240-3.08	V_{CC} = 3.6V		7	**10**	
V_{TH}	Reset Threshold	SM72240-4.63		4.54 **4.50**	4.63	4.72 **4.75**	V
		SM72240-3.08		3.03 **3.00**	3.08	3.14 **3.15**	
V_{TH} Tempco	Reset Threshold Temperature Coefficient				30		ppm/°C
t_{RD}	V_{CC} to Reset Delay (*Note 5*)	V_{CC} = V_{TH} to (V_{TH} − 100mV)			20		µs
t_{RP}	Reset Active Timeout Period			**100**	190	**560**	ms
t_{MR}	$\overline{MR}$ Minimum Pulse Width			**10**			µs
t_{MD}	$\overline{MR}$ to Reset Propagation Delay				2		µs
	$\overline{MR}$ Glitch Immunity (*Note 6*)				100		ns
V_{IH}	$\overline{MR}$ Input Threshold	V_{CC} > $V_{TH(MAX)}$		**2.3**			V
V_{IL}						**0.8**	
	$\overline{MR}$ Pull-Up Resistance				22		kΩ
V_{OL}	$\overline{RESET}$Output Voltage Low	V_{CC} = V_{TH} min, I_{SINK} = 3.2 mA				**0.4**	V
		V_{CC} > 1V, I_{SINK} = 50µA				**0.3**	
I_{IN}	$\overline{RESET}$ Output Leakage Current (SM72240)	V_{CC} > V_{TH}, $\overline{RESET}$ = 5.5V				**0.5**	µA

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which the device operates correctly. Operating ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics.

Note 2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Note 3: At elevated temperatures, devices must be derated based on package thermal resistance. The device must be derated at 4.5mW/°C at ambient temperatures above 70°C. The device has internal thermal protection.

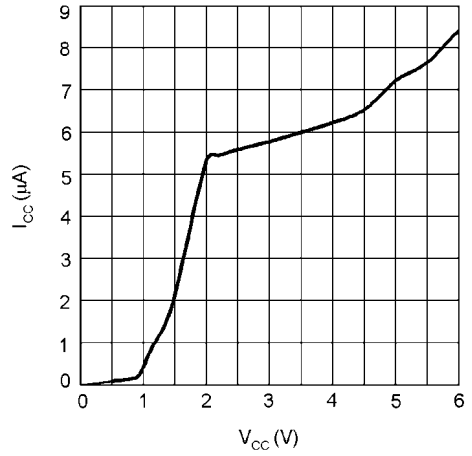
Note 4: Production testing done at T_A = +25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods.

Note 5: $\overline{RESET}$ Output.

Note 6: Glitches of 100 ns or less typically will not generate a reset pulse.

Typical Performance Characteristics

Supply Current vs V_{CC}



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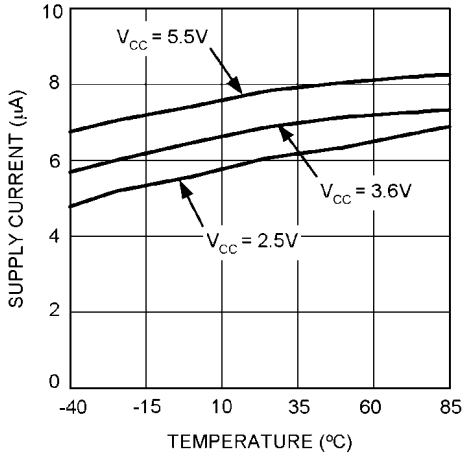
Supply Current vs Temperature



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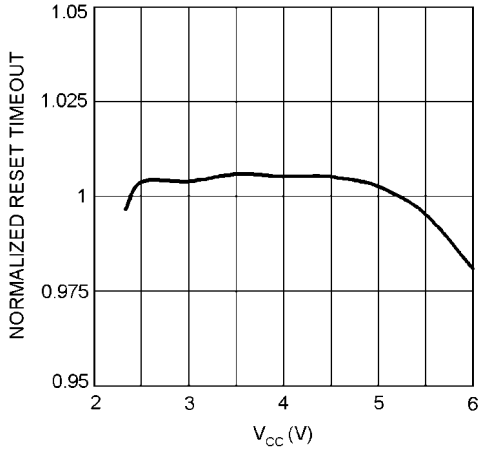
Reset Timeout vs V_{CC}



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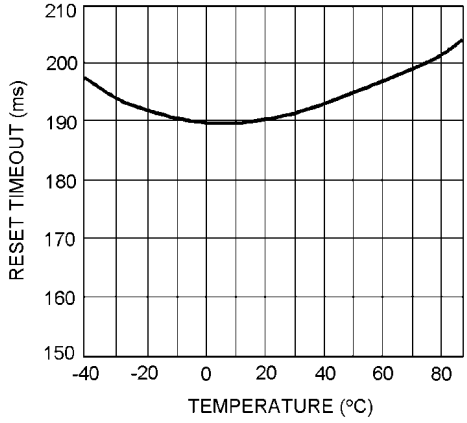
Reset Timeout vs Temperature



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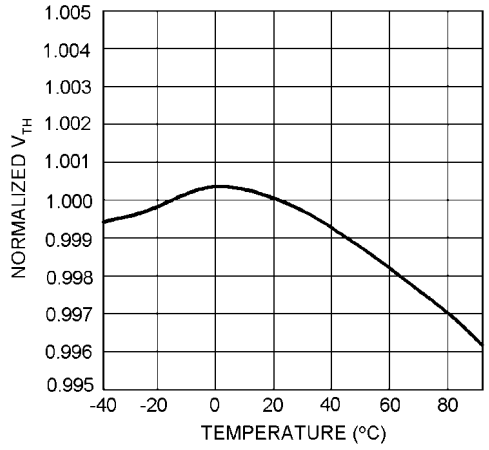
Normalized V_{TH} vs Temperature



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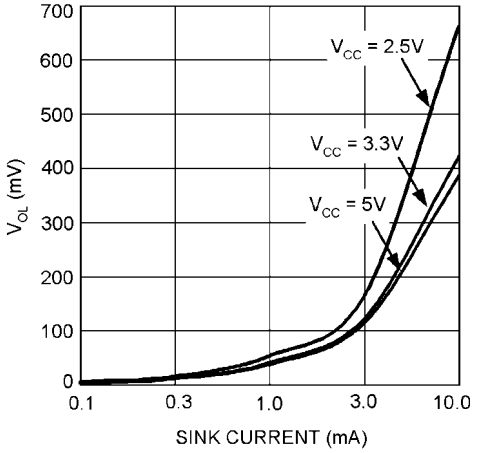
V_{OL} vs Current



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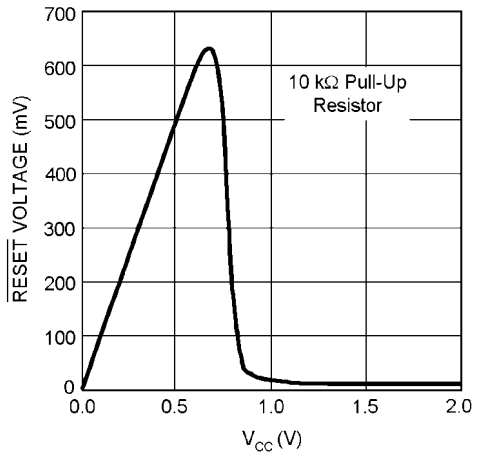
Low V_{CC} Characteristics



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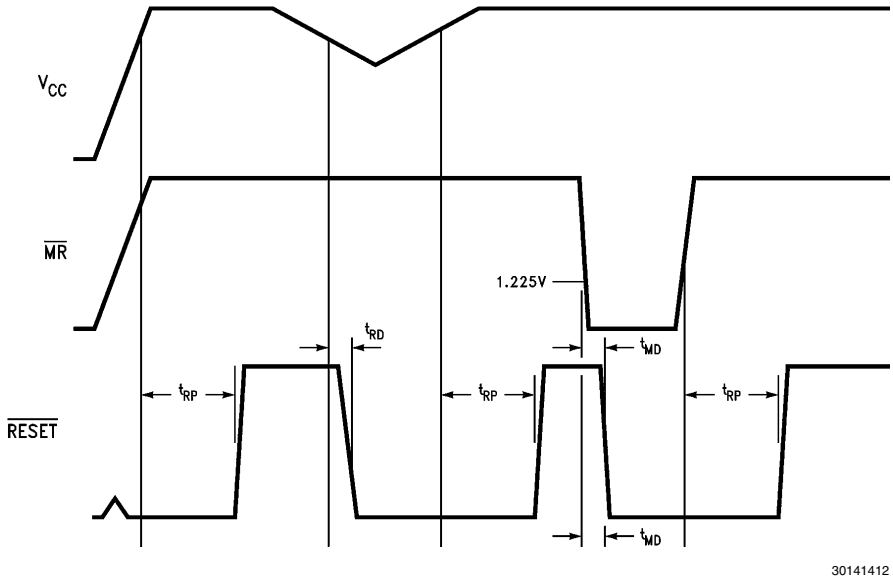
Timing Diagram



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Circuit Information

RESET OUTPUT

The reset input of a µP initializes the device into a known state. The SM72240 microprocessor voltage monitoring circuit asserts a forced reset output to prevent code execution errors during power-up, power-down, and brownout conditions.

$\overline{\text{RESET}}$ is guaranteed valid for $V_{CC} \geq 1V$. Once V_{CC} exceeds the reset threshold, an internal timer maintains the output for the reset timeout period. After this interval, reset goes high and the microprocessor initializes itself into a known state. $\overline{\text{RESET}}$ is active low.

As V_{CC} drops below the reset threshold (such as during a brownout), the reset activates (see the *Negative-Going V_{CC} Transients* section). When V_{CC} again rises above the reset threshold, the internal timer starts. Reset holds until V_{CC} exceeds the reset threshold for longer than the reset timeout period. After this time, reset releases.

Additionally, the Manual Reset input ($\overline{\text{MR}}$) will initiate a forced reset. See the *Manual Reset Input* section.

The SM72240 reset output ignores short duration glitches on V_{CC} and $\overline{\text{MR}}$. See the *Applications Information* section for details.

RESET THRESHOLD

The SM72240 is available with a reset voltage of 4.63V or 3.08V which are suitable for monitoring 5.0V or 3.3V supplies respectively.

MANUAL RESET INPUT ($\overline{\text{MR}}$)

Many µP-based products require a manual reset capability, allowing the operator to initiate a reset. The $\overline{\text{MR}}$ input is fully debounced and provides an internal 22 kΩ pull-up. When the $\overline{\text{MR}}$ input is pulled below V_{IL} ($0.25V_{CC}$) for more than 100 ns, reset is asserted after a typical delay of 2 µs. Reset remains active as long as $\overline{\text{MR}}$ is held low, and releases after $\overline{\text{MR}}$ rises above V_{IH} and the reset timeout period expires. Use $\overline{\text{MR}}$ with digital logic to assert reset or to daisy chain supervisory circuits.

Applications Information

BENEFITS OF PRECISION RESET THRESHOLDS

A microprocessor supply supervisor must provide a reset output within a predictable range of the supply voltage. A common threshold range is between 5% and 10% below the nominal supply voltage. The SM72240 uses highly accurate circuitry to ensure that the reset threshold occurs only within this range (for 5.0V and 3.3V supplies). *Table 1* shows how the standard reset threshold applies to 5.0V and 3.3V nominal supply voltages.

TABLE 1. Monitored Tolerance Table

Reset Threshold	Supply Voltage	
	3.3V	5.0V
4.63 ± %		90.8-94.4%
3.08 ± %	91.8–95.2%	

ENSURING A VALID RESET OUTPUT DOWN TO V_{CC} = 0V

When V_{CC} falls below 1V, the SM72240 $\overline{\text{RESET}}$ output is unable to sink the rated current. A high-impedance CMOS logic input connected to $\overline{\text{RESET}}$ can therefore drift to undetermined voltages. To prevent this situation, a 100kΩ resistor should be connected from the $\overline{\text{RESET}}$ output to ground, as shown in *Figure 1*.

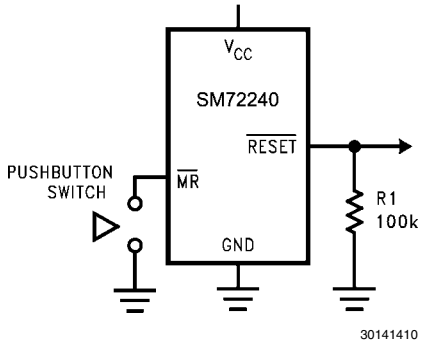


FIGURE 1. Circuit for $\overline{\text{RESET}}$ Valid from V_{CC} = 0V

OPEN DRAIN OUTPUT

An open drain output allows easy paralleling of multiple microprocessor reset circuits without requiring additional logic gates. Open drain outputs also allow interfacing devices of differing logic levels or families, since the output pull-up resistor may be connected to any supply voltage up to 5.5V, regardless of V_{CC}.

The pull up resistor is calculated so that maximum current flow into $\overline{\text{RESET}}$ is less than 10 mA when activated. The resistor must be small enough so that the leakage current of all connected devices does not create an excessive voltage drop when the output is not activated. A resistor value of 100 kΩ will generally suffice.

NEGATIVE-GOING V_{CC} TRANSIENTS

The SM72240 is relatively immune to short negative-going transients or glitches on V_{CC}. *Figure 2* shows the maximum pulse width a negative-going V_{CC} transient can have without causing a reset pulse. In general, as the magnitude of the transient increases, going further below the threshold, the maximum allowable pulse width decreases. Typically, a V_{CC} transient that goes 125 mV below the reset threshold and lasts 40 µs or less will not cause a reset pulse. A 0.1 µF bypass capacitor mounted as close as possible to the V_{CC} pin will provide additional transient rejection.

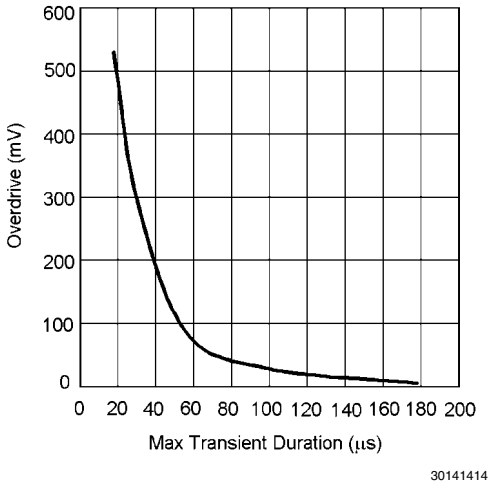
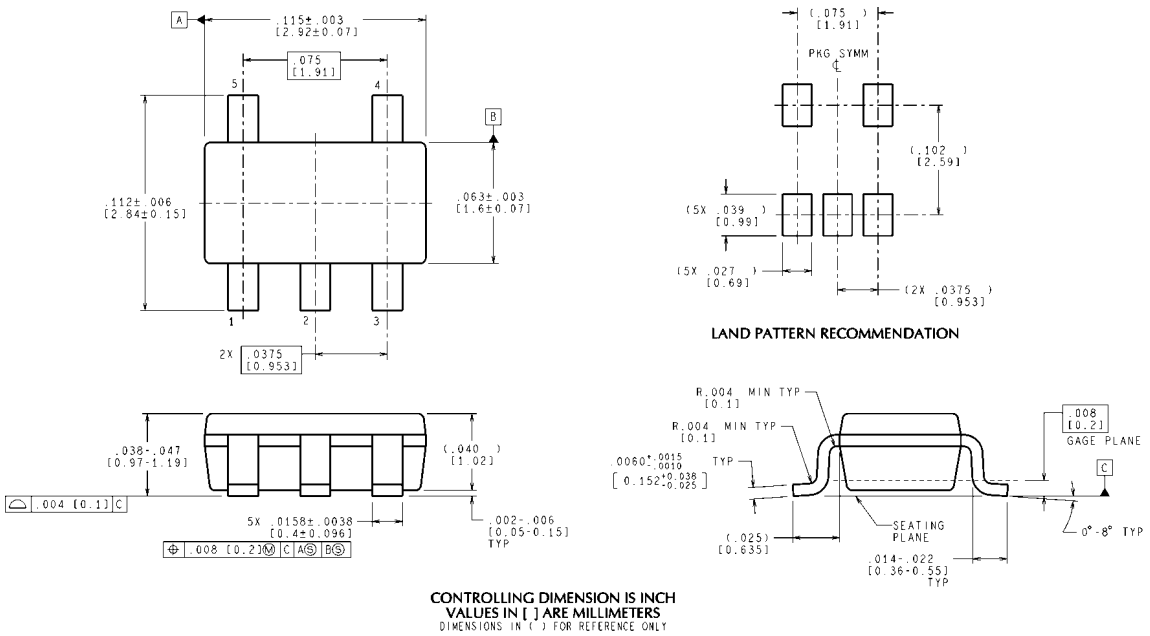


FIGURE 2. Maximum Transient Duration without Causing a Reset Pulse vs. Reset Comparator Overdrive

Physical Dimensions inches (millimeters) unless otherwise noted



MF05A (Rev D)

5-Lead SOT23-5
For Ordering, refer to Ordering Information table
NS Package Number MF05A

Notes

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